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An evaluation of noninvasive mechanical ventilation application in intensive care

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ABSTRACT

Aims: Noninvasive mechanical ventilation (NIMV) is a positive pressure treatment applied with a mask without the need for endotracheal intubation in patients with acute and chronic respiratory failure. C-reactive protein (CRP), procalcitonin (PCT), albumin, red blood cell distribution width (RDW), and mean platelet volume (MPV) are frequently used markers in clinical practice. Arterial blood gas (ABG) analysis is a standard method in clinical practice in intensive care, which is known to have a higher risk of complications than venous blood gas (VBG) analysis. Studies have shown a strong correlation between ABG and VBG with regard topH, partial arterial carbon dioxide pressure ($PaCO_2$), and serum bicarbonate (HCO_3). In this study, we aimed to evaluate the relationship between CRP, PCT, albumin, MPV, and RDW and in-hospital mortality and acute respiratory failure in patients undergoing NIMV. Our secondary aim was to evaluate the relationship between these parameters and VBG values.

Methods: Patients with acute hypoxemic and hypercapnic respiratory failure that underwent NIMV in intensive care unit (ICU) were evaluated retrospectively.

Results: The study included 99 patients with a mean age of 69.39±9.79 years. In-hospital mortality occurred in 5 (5.1%) patients. Hypercapnic respiratory failure was detected in 66 (66.7%), hypoxemic respiratory failure in 19 (19.2%), and hypoxemic + hypercapnic respiratory failure in 14 (14.1%) patients. PCT was significantly higher in patients with acute hypoxemic respiratory failure and MPV was significantly higher in patients with acute hypercapnic respiratory failure compared to other patients ($p<0.05$ for both). Both MPV and RDW were significantly higher in patients with in-hospital mortality ($p<0.05$). The baseline and 24-h PO_2/FiO_2 ratios were significantly lower in patients with acute hypoxemic+hypercapnic respiratory failure ($p<0.05$). The 24-h PO_2/FiO_2 ratio was significantly lower in patients with in-hospital mortality compared to patients without mortality ($p<0.05$).

Conclusion: Both RDW and MPV should be employed in predicting mortality in patients undergoing NIMV due to acute respiratory failure. Further multicenter, prospective studies are needed to evaluate the PaO_2/FiO_2 ratio particularly in VBG in patients receiving NIMV due to acute respiratory failure.

Keywords: Mean platelet volume, noninvasive mechanical ventilation, red blood cell distribution width, venous blood gas

INTRODUCTION

Noninvasive mechanical ventilation (NIMV) is a positive pressure treatment applied with a mask without the need for endotracheal intubation in patients with acute and chronic respiratory failure. Physiopathologically, NIMV promotes alveolar ventilation, reduces pulmonary workload, and provides improvement in the ventilation/perfusion ratio. NIMV is frequently administered in clinical practice without delaying invasive mechanical ventilation in acute hypoxemic or hypercapnic respiratory failure.[1,2] NIMV may help reduce the intubation rate, hospitalization period, and mortality. Moreover, NIMV is considered the gold standard, particularly in acute hypercapnic respiratory failure.[3] Within the first 1-2 hours of NIMV commencement, a number of significant contributions of NIMV including improvement in pH and partial arterial oxygen pressure (PaO_2) and reduction in respiratory rate and partial arterial carbon dioxide pressure ($PaCO_2$) can be observed.[4]

It is known that the pulmonary and systemic inflammatory response is increased in patients receiving invasive

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mechanical ventilation (IMV). Additionally, increased inflammatory markers have been reported in patients with chronic obstructive pulmonary disease (COPD) receiving long-term NIMV at home.[3] Serum procalcitonin (PCT) is a polypeptide of a small molecular weight substance synthesized by C cells of the thyroid gland. Additionally, PCT has also been shown to be secreted in bacterial infections and severe systemic reactions and it is practically used to differentiate bacterial infections. C-reactive protein (CRP) is an acknowledged acute inflammatory response marker. Studies have shown that both PCT and CRP increase as a result of oxidative stress and inflammatory immune response.[1] In some other studies, PCT levels have been shown to be higher in patients that received NIMV in intensive care unit (ICU) compared to patients that did not. Moreover, in exacerbation of COPD, both PCT and CRP levels have been found to be higher in the group with NIMV failure.[5] Red blood cell distribution width (RDW) and mean platelet volume (MPV) are well-known complete blood count (CBC) measures routinely used in clinical practice and are also acute phase parameters associated with inflammation and used to predict mortality. MPV is an indicator of platelet activation and may be detected at low levels in the inflammation site in clinical conditions such as sepsis since it is a marker of accumulation in that site. There are studies reporting on an association between the RDW value assessed during ICU admission and respiratory failure. In a retrospective study by Zheng et al.[6], high CRP and MPV values in IMV were associated with weaning failure.[7] Similarly, high CRP and low albumin levels have been associated with NIMV failure in patients receiving NIMV in ICU.[4]

Arterial blood gas (ABG) and venous blood gas (VBG) are frequently used parameters in ICU practice. Although ABG analysis is a standard method, it has a higher risk of complications than VBG analysis. In a study evaluating 246 patients admitted to the emergency department, 196 of whom had respiratory failure, a high degree of correlation was found between venous and arterial pH estimation.[8] Moreover, in a study that evaluated 132 patients with COPD, a strong correlation was found between ABG and VBG with regard to pH, PaCO2, and serum bicarbonate (HCO_3).[9]

In this retrospective study, we aimed to evaluate the relationship between the CRP, PCT, albumin, MPV, and RDW values measured at the time of admission and in-hospital mortality and acute respiratory failure in patients undergoing NIMV [bilevel-positive airway pressure (BiPAP)] due to acute hypoxemic and hypercapnic respiratory failure. Our secondary aim was to evaluate the relationship between these values and VBG values.

METHODS

After obtaining an ethics committee approval from Pamukkale University Non-interventional Clinical Researches Ethics Committee (Date: 03.07.2019, Decision No: 60116787-020/45998), patients that underwent NIMV due to acute hypercapnic and hypoxemic respiratory failure in ICU were evaluated retrospectively. Patients aged below 18 years, pregnant women, and those with NIMV contraindications (e.g. cardiac and respiratory arrest, hemodynamic instability, myocardial infarction, arrhythmia, trauma, craniofacial anomalies, encephalopathy, surgery, upper gastrointestinal bleeding), and patients with IMV were excluded from the study. All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

The CRP, PCT, albumin, RDW, and MPV values measured at ICU admission were recorded for each patient. The Acute Physiology and Chronic Health Evaluation (APACHE) II and Sequential Organ Failure Assessment Score (SOFA) scores of the patients were retrieved from hospital databases.[10] Since all the patients included in the study had VBG values, the pH, $PaCO_2$, PaO_2 and oxygen saturation (SO_2) values were measured from venous blood samples. Due to the retrospective nature of the study, ABG samples could not be obtained at the 24th hour of ICU admission. For this reason, the ratio of PaO_2 to the inspired oxygen (FiO_2) at admission and at the 24th hour was calculated according to the PaO_2 measured from venous blood samples. CBC was performed using the photometric method, the CRP and albumin levels were assessed using the turbidimetric method, and PCT levels were measured using the immunoassay method. Normal ranges of RDW, MPV, CRP, and albumin were 11.6-17.2%, 7.8-11 fL, 0-5 mg/L, and 3.5-7.2 mg/L, respectively. All the patients included in the study received NIMV with BIPAP-ST in ICU. In all patients, the tidal volume was adjusted to 6 ml per kilogram of predicted body weight. During NIMV, the initial pressure support ventilation (PSV), positive end-expiratory pressure (PEEP), and FiO_2 values were recorded for each patient. Respiratory failure was defined as PaO_2 below 60 mmHg and $PaCO_2$ above 45 mmHg in ABG. Patients were divided into two groups: (i) hypoxemic and (ii) hypercapnic respiratory failure. Hypoxemic respiratory failure was defined as PaO_2<60 mmHg and hypercapnic respiratory failure was defined as $PaCO_2$>45 mmHg.[11]

Statistical Analysis

Data were analyzed using IBM SPSS for Windows version 27.0 (Armonk, NY: IBM Corp.). Continuous variables were expressed as mean±standard deviation (SD) and categorical variables were expressed as frequencies (n) and percentages (%). Normal distribution of continuous variables was assessed using Kolmogorov-Smirnov test.Two groups were compared using Mann-Whitney U test or independent samples t-test as appropriate. Three or more groups were compared using Kruskal-Wallis H test or one-way ANOVA test as appropriate. For all analyses, a p value of <0.05 was considered significant.

RESULTS

The study included 99 patients (26.3% female and 73.7% male) with a mean age of 69.39±9.79 years. In-hospital mortality occurred in 5 (5.1%) patients. IMV was used in 17 (17.2%) patients within the first 24 hours of ICU admission. Of all patients, 18 (18.2%) had pneumonia and 81 (81.8%) had COPD. Hypercapnic respiratory failure was detected in 66 (66.7%), hypoxemic respiratory failure in 19 (19.2%), and hypoxemic+hypercapnic respiratory failure in 14 (14.1%) patients. Sedation was performed in 11 (11.1%) patients. Mean APACHE II and SOFA scores were 17.11±5.66 and 5.20±2.46, respectively. Mean serum levels of CRP, PCT, RDW, MPV and albumin were 72.80±85.20 mg/ml, 0.57±1.83 ng/ml, 17.16%±4.84%, 9.21±1.23 fl, and 32.94±5.33 g/L, respectively. Mean PSV, PEEP, and FiO2 values were 19.42±7.53, 7.60±1.48, and 60.58±16.54, respectively. Table 1 presents the laboratory parameters measured at admission.

Table 1. Baseline laboratory parameters

Variables	Mean±SD
PO_2(mmHg)/FiO_2	72.08±31.48
PO_2(mmHg)/FiO_2 (24-h)	88.55±32.88
VBG-pH	7.33±0.09
VBG- PCO_2 (mmHg)	67.41±17.69
VBG-PO_2 (mmHg)	40.65±11.62
SO_2 (%)	65.34±14.66
CRP (mg/L	72.80±85.20
PCT (ng/mL)	0.57±1.83
RDW (%)	17.16±4.84
Albumin (g/L)	32.94±5.33
MPV (fL)	9.21±1.23

CRP: C-reactive protein, PCT: Procalcitonin, RDW: Red blood cell distribution width, MPV: Mean platelet volume, VBG: Venous blood gas, PO_2/FO_2: Ratio of partial oxygen pressure to inspired oxygen, PO_2: Partial oxygen pressure, PCO2: Partial carbon dioxide pressure, SO_2: Oxygen saturation, SD: Standard deviation

In patients with COPD, the SOFA score and the PO_2/FiO_2 ratio at 24 hours were significantly higher and the PCT values at admission were significantly lower than those of patients with pneumonia (p<0.05 for all). However, no significant difference was found between the two groups with regard to PSV, PEEP, and FiO_2 values (p=0.385, p=0.252, and p=0.293, respectively) Table 2. In patients that received sedation during NIMV, the APACHE II score and FiO_2 value were significantly higher and the PCT value was significantly lower than those of other patients (p=0.001, p=0.018, and p=0.020, respectively).

Table 2. Association of other parameters in COPD and pneumonia groups

Variables	Pneumonia (n=18)	COPD (n=81)	p
	Mean± SD	Mean± SD	
APACHE	17.28±8.00	17.07±5.06	0.960[b]
SOFA	4.78±3.80	5.30±2.08	0.043[b]
PO_2 (mmHg)/FiO_2	59.79±18.14	74.81±33.20	0.091[b]
PO_2 (mmHg)/FiO_2 (24-h)	74.73±28.06	91.66±33.23	0.048[a]
pH	7.31±0.10	7.34±0.09	0.284[a]
PCO_2 (mm/Hg)	60.90±21.83	68.85±16.45	0.085[a]
PO_2 (mm/Hg)	38.97±12.25	41.02±11.53	0.490[b]
SO_2 (%)	63.75±17.09	65.69±14.16	0.860[b]
NIMV PSV	18.17±3.76	19.70±8.13	0.385[b]
NIMV PEEP	7.22±1.52	7.68±1.47	0.252[b]
FiO_2 (%)	63.33±14.95	59.96±16.89	0.293[b]
CRP (mg/L)	104.29±102.16	65.80±80.01	0.127[b]
PCT (ug/L)	1.46±3.06	0.37±1.37	0.001[b]
RDW (%)	16.30±1.92	17.35±5.10	0.376[b]
Albumin (g/L)	33.13±6.40	32.90±5.10	0.866[a]
MPV (fL)	9.11±1.74	9.23±1.10	0.690[a]

p<0.05; a=T-Test; b=Mann Whitney-U Test
COPD: Chronic obstructive pulmonary disease, APACHE II: Acute physiology and chronic health evaluation II, SOFA: Sequential organ failure assessment score, CRP: C-reactive protein, PCT: Procalcitonin, RDW: Red blood cell distribution width, MPV: Mean platelet volume, VBG: Venous blood gas, PO2/FiO2: Ratio of partial oxygen pressure to inspired oxygen, PO2: Partial oxygen pressure, PCO2: Partial carbon dioxide pressure, SO2: Oxygen saturation, NIMV: Noninvasive mechanical ventilation, PSV: Pressure support ventilation, PEEP: Positive end-expiratory pressure, FiO2: Inspired oxygen, SD: Standard Deviation

In patients with acute hypoxemic respiratory failure, the SOFA score and the PCO_2 and PSV values were significantly lower and the PCT value was significantly higher than those in patients with acute hypercapnic respiratory failure and hypoxemic + hypercapnic respiratory failure (p<0.05 for all). Both the admission and 24-h PO_2/FiO_2 and MPV values were significantly higher in patients with acute hypercapnic respiratory failure compared to patients with acute hypoxemic and hypoxemic+hypercapnic respiratory failure (p<0.05). In patients with acute hypoxemic+hypercapnic respiratory failure, pH was significantly lower and FiO_2 was significantly higher in VBG compared to other patients (p<0.05) Table 3.

Table 3. Relationship between causes of acute respiratory failure and other parameters

Variables	Acute hypoxic respiratory failure (n=19)	Acute hypercapnic respiratory failure (n=66)	Acute hypercapnic +hypoxemic respiratory failure (n=14)	p
	Mean± SD	Mean± SD	Mean± SD	
APACHE II	15.79±7.81	17.15±4.58	18.71±6.82	0.125[b]
SOFA	4.32±3.28	5.32±1.95	5.86±3.18	0.043[b]
PO_2(mmHg)/ FiO_2	62.22±23.69	78.65±34.25	54.48±11.55	0.010[b]
PaO_2(mmHg)/ FiO_2 (24-h)	77.29±32.44	94.79±33.10	73.32±23.61	0.023[a]
pH	7.34±0.09	7.34±0.09	7.27±0.09	0.017[a]
PCO_2 (mmHg)	48.70±15.20	72.22±15.71	70.09±12.97	0.001[a]
PO_2 (mmHg)	38.52±12.76	41.58±11.82	39.16±9.02	0.505[b]
SO_2 (%)	58.29±17.03	67.30±13.73	65.63±13.53	0.109[b]
NIMV PSV	16.74±3.02	20.15±8.80	19.64±3.84	0.021[b]
NIMV PEEP	7.53±1.47	7.67±1.44	7.36±1.78	0.723[b]
FiO_2 (%)	64.74±17.12	57.08±15.77	71.43±14.06	0.003[b]
CRP (mg/L)	100.85±98.56	66.26±83.84	65.55 ±68.58	0.288[b]
PCT (ug/L)	1.34±3.01	0.40±1.51	0.31±0.22	0.032[b]
RDW (%)	18.19±10.13	16.77±2.26	17.58±2.48	0.265[b]
Albumin (g/L)	32.18±5.25	32.62±5.10	35.49±6.13	0.148[a]
MPV (fL)	8.56±1.70	9.45±1.03	8.96±1.08	0.014[a]

p<0.05; a=One-way ANOVA, b=Kruskal-Wallis Test
APACHE II: Acute physiology and chronic health evaluation II, SOFA: Sequential organ failure assessment score, CRP: C-reactive protein, PCT: Procalcitonin, RDW: Red blood cell distribution width, MPV: Mean platelet volume, VBG: Venous blood gas, PO2/FiO2: Ratio of partial oxygen pressure to inspired oxygen, PO2: Partial oxygen pressure, PCO2: Partial carbon dioxide pressure, SO2: Oxygen saturation, NIMV: Noninvasive mechanical ventilation, PSV: Pressure support ventilation, PEEP: Positive end-expiratory pressure, FiO2: Inspired oxygen, SD: Standard Deviation

In patients that underwent IMV, the PO_2/FiO_2 ratio and the pH and SO_2 values assessed at admission and 24 hours were significantly lower and the FiO_2 and admission PCT values were significantly higher than those in other patients (p=0.004, p=0.016, p=0.040, p=0.016, p=0.001, and p=0.004, respectively).

In patients with in-hospital mortality, the SOFA score, the PO_2/FiO_2 ratio at 24 hours, and the PO_2 and SO_2 values were significantly lower compared to those in patients without mortality (p<0.05 for all). Additionally, the admission RDW and MPV values significantly higher in patients with in-hospital mortality compared to other patients (p<0.05 for all) Table 4.

Table 4. Relationship between in-hospital mortality and other parameters

Variables	In-hospital mortality		
	No (n=94)	Yes (n=5)	p
	Mean± SD	Mean± SD	
APACHE II	17.10±5.64	17.40±6.66	0.923[b]
SOFA	5.31±2.47	3.20±1.30	0.038[b]
PO2 (mmHg)/FiO2	72.99±31.84	54.96±17.71	0.215[b]
PO2 (mmHg)/FiO2 (24-h)	90.03±32.72	53.75±9.05	0.030[a]
pH	7.33±0.09	7.33±0.06	0.996[a]
PCO2 (mmHg)	68.18±17.36	52.90±19.67	0.060[a]
PO2 (mmHg)	41.25±11.46	29.32±9.48	0.022[b]
SO2 (%)	66.35±13.93	46.26±16.49	0.011[b]
NIMV PSV	19.50±7.71	18.00±2.45	0.580[b]
NIMV PEEP	7.55±1.47	8.40±1.67	0.232[b]
FiO2 (%)	59.97±16.14	72.00±21.68	0.239[b]
CRP (mg/L)	71.36±85.95	99.80±71.74	0.150[b]
PCT (ug/L)	0.57±1.87	0.57±0.71	0.105[b]
RDW (%)	17.06±4.93	19.04±1.69	0.014[b]
Albumin (g/L)	33.03±5.43	31.20±2.17	0.456[a]
MPV (fL)	8.00±0.54	9.28±1.23	0.023[a]

p<0.05; a=T-test; b=Mann-Whitney U Test
APACHE II: Acute physiology and chronic health evaluation II, SOFA: Sequential organ failure assessment score, CRP: C-reactive protein, PCT: Procalcitonin, RDW: Red blood cell distribution width, MPV: Mean platelet volume, VBG: Venous blood gas, PO2/FiO2: Ratio of partial oxygen pressure to inspired oxygen, PO2: Partial oxygen pressure, PCO2: Partial carbon dioxide pressure, SO2: Oxygen saturation, NIMV: Noninvasive mechanical ventilation, PSV: Pressure support ventilation, PEEP: Positive end-expiratory pressure, FiO2: Inspired oxygen, SD: Standard Deviation

DISCUSSION

Our results indicated that the RDW and MPV values in patients with in-hospital mortality, the PCT values in patients with acute hypoxemic respiratory failure, and the MPV values in patients with acute hypercapnic respiratory failure were significantly higher compared to those in other patients. The admission and 24-h PO_2/FiO_2 ratio were significantly lower in patients with acute hypercapnic + hypoxemic respiratory failure compared to patients with acute hypoxemic respiratory failure and patients with acute hypercapnic respiratory failure. Moreover PCO_2 level was significantly higher in patients with acute hypercapnic+hypoxemic respiratory failure compared to patients with acute hypoxemic respiratory failure. However, the PO_2/FiO_2, PO_2, and SO_2 values were significantly lower in patients with in-hospital mortality compared to patients without mortality.

Studies suggest that VBG can be preferred over ABG, particularly in the evaluation of the acid-base balance.[8,9] It has also been shown that the SO_2/FiO_2 ratio can be preferred over the PaO_2/FiO_2 ratio in ICU patients receiving NIMV.[12-14] In a multicenter study evaluating patients admitted to hospital due to an acute illness, the SO_2/FiO_2 ratio was assessed on days 1, 2, 3, and 7 and the results indicated that the SO_2/FiO_2 ratios assessed on day 1 and 2 were useful in predicting in-hospital mortality.[15] Due to the retrospective nature of our study, the assessment of the parameters was performed by VBG analysis, which is frequently used in ICU practice. Instead of the SO_2/FiO_2 ratio, the PO_2/FiO_2 ratio obtained at admission and 24 hours was analyzed. To our knowledge, there is no study in the literature evaluating VBG-based parameters and the PO_2/FiO_2 ratio in patients undergoing NIMV due to acute respiratory failure. Our analyses indicated that the 24-h PO_2/FiO_2 and PO_2 values in patients with in-hospital mortality and both the admission and 24-h PO_2/FiO_2 ratios in patients with acute hypercapnic+hypoxemic respiratory failure were significantly lower than those in patients with acute hypoxemic respiratory failure and patients with hypercapnic respiratory failure. Nevertheless, in our study, the PO_2/FiO_2 ratio obtained in patients undergoing NIMV could not be compared with the data in the literature due to the lack of studies on the relationship between the PO_2/FiO_2 ratio and mortality or types of acute respiratory failure.

Serum albumin level is a significant parameter in malnutrition-related inflammatory response syndrome. The effects of serum albumin level on NIMV include hypoalbunemia, respiratory muscle weakness, and decreased lung function.[16] In a study evaluating patients with COPD hospitalized in ICU, a negative correlation was found between in-hospital mortality and serum albumin level <3 g/dL.[17] In another study that was conducted in patients with COPD, low serum albumin level was found to be associated with an increase in hospitalization, acute respiratory failure, and mortality.[18] However, in our study, no significant relationship was found between serum albumin level and mortality or types of acute respiratory failure. This finding could be attributed to the fact that serum albumin level was assessed with a single measurement and the parameters that could affect serum albumin level such as kidney and liver function tests and nutritional status were not evaluated.

CRP and PCT are acknowledged biomarkers frequently used in daily clinical practice. CRP increases in systemic inflammation although it has a low sensitivity and specificity. PCT, on the other hand, has been shown to be an indicator of both bacterial infection and oxidative stress. This biomarker is particularly used in antimicrobial treatment decisions. In a study conducted in patients with COPD, increased CRP and PCT levels were found to be significantly associated with NIMV failure. In some other studies, a PCT level of >0.24-0.25 ng/ml was found to be associated with increased mortality rate.[19,20] In a study conducted in patients with COPD, it was reported that an increase of over 50% in PCT was associated with the requirement of IMV during NIMV and with increased clinical mortality.[5] On the other hand, increased CRP has been shown to be an independent factor for mortality, particularly in patients with COPD.[20-22] In our study, CRP did not establish a significant relationship with acute respiratory failure types and mortality. In contrast, although PCT established no significant relationship with mortality, it was significantly higher in patients with acute hypoxemic respiratory failure. These findings are inconsistent with those reported in the literature ,which could be ascribed to the fact that the PCT level was assessed with a single measurement, its assessment could not be standardized due to the retrospective nature of the study, and the parameters that could affect the PCT level such as kidney and liver function tests were not evaluated.

Both RDW and MPV are routinely measured parameters in CBC analysis. Platelets are significant indicators of inflammation and immunity. MPV is a simple and practical

indicator of platelet functions. In some ICU studies, increased MPV and RDW levels have been shown to be poor prognostic factors particularly for diabetes mellitus, coronary artery disease, pulmonary thromboembolism, and COPD. In a study evaluating patients with IMV, increased MPV levels were detected in patients with weaning failure.[6] In another study, in-hospital mortality was found to be associated with increased MPV in patients followed up in ICU due to pneumonia. The authors also noted that the MPV value is affected by age, kidney functions, and the presence of peripheral arterial diseases.[23] In a study evaluating COPD patients receiving NIMV, increased RDW levels were found to be a negative prognostic factor and also an increase in RDW within the first three days of ICU hospitalization was found to be a poor prognostic factor for mortality.[24] In a study evaluating 153 hospitalized patients with community-acquired pneumonia, increased RDW and MPV values were associated with high mortality.[25] Similarly, in our study, both RDW and MPV values were significantly higher in patients with mortality and the MPV value was significantly higher in patients with acute hypercapnic respiratory failure. Although the RDW value was higher in patients with acute hypoxemic respiratory failure, the difference was statistically insignificant. These findings could not be compared with the literature since, to our knowledge, there is no study in the literature evaluating the relationship between RDW and MPV and types of acute respiratory failure.

Limitations

Our study was limited in several ways. First and foremost, it was a retrospective study and had a small number of patients. Second, serum levels of CRP, PCT, albumin, RDW, and MPV were assessed with a single measurement and no serial measurements were performed, and thus no standardization was established. Finally, in-hospital mortality was assessed independently.

CONCLUSION

Our study is a rare study that evaluated VBG in patients that underwent NIMV due to acute respiratory failure. The results indicated that RDW and MPV values should be taken into consideration in predicting mortality. Further multicenter, prospective studies are needed to evaluate the PO_2/FiO_2 ratio particularly in VBG.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of Pamukkale University Non-interventional Clinical Researches Ethics Committee (Date:03.07.2019, Decision No: 60116784-020-45998).

Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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